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STUDIES IN THE BULBOUS LILIACEAE IN SOUTH AFRICA: 3. THE MEIOTIC CHROMOSOMES OF *LEDEBOURIA*

J. P. Jessop

(*Schonland Botanical Laboratory, Rhodes University*)

Abstract

33 specimens of nine species of *Ledebouria* Roth were examined cytologically. Haploid numbers were found to be very variable within the species and no basic number can be proposed. Meoitic abnormalities were observed in very few specimens. No correlation was found between chromosome numbers and plant morphology.

Uittreksel

STUDIES VAN DIE BOLDRAENDE LILIACEAE IN SUID-AFRIKA:
3 DIE MEÏOTIESE CHROMOSOME VAN *LEDEBOURIA*.
33 Monsters van nege soorte *Ledebouria* Roth was sitologies bestudeer. Dit is bevind dat haploïde nommers binne die soort baie veranderlik kan wees en geen basiese nommer kan voorgestel word nie. Meïotiese abnormaliteite word in 'n paar monsters aangetref. Geen korrelasie word tussen chromosoom nommers en plant morfologie gevind nie.

Introduction

Prior to the present author's report on *Ledebouria* cytology in 1970, only two papers, dealing with the chromosomes of South African members of this genus, had been published (Giménez-Martin, 1959, and Fernandes & Neves, 1962). Giménez-Martin reported a somatic number of 12 for *L. graminofolia* (Bak.) Jess. (sub *Scilla stenophylla*) and Fernandes & Neves reported a somatic number of 24 for *L. apertiflora* (Bak) Jess. (sub *S. linearifolia*). Three papers on *L. hyacinthina* (sub *Scilla indica*), which is an Indian species, give somatic numbers of 30, 44, 45, 46, 58 and 60 (Rao, 1953 & 1956, and Sheriff & Murthy, 1946).

The present study was undertaken to provide information which might be of value in determining relationships between *Ledebouria* and other genera in the bulbous Liliaceae, to assist in the subdivision of the genus and also to obtain information on the occurrence of abnormalities during meiosis.

Methods

Pollen mother cells were used throughout the investigation. No fixation or other pre-staining treatments were employed. Anthers were dissected out of buds and sqaushed in lacto-propiono-orcein, prepared as described in Haskell & Wills (1968).

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Material was either photographed or drawn under a camera-lucida. Measurements were taken from the photographs (employing where necessary photographs taken in different planes) or from the camera-lucida drawings. The drawings accompanying the photographs in this paper were drawn from the photographs, using sketches made from the original preparations.

Satellites and heterochromatic regions were not detected and centromeres were usually not identifiable. It was found that the chromosomes did not fall into natural size groups. In calculating average sizes the measurements for each complement were placed in decending order of size and it was assumed that chromosomes in equivalent position in the order in different cells were homologous. Drawings of leaves were made from herbarium material of the actual specimens employed in the cytological investigations.

RESULTS

Ledebouria cooperi (Hook. f.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
TRANSVAAL—2427 (Thabazimbi): Bakkerspas	*Jessop 1061* (GRA)	10	10
NATAL—3030 (Port Shepstone): Mgongongo tributary to Tsotsha River, Wickman's Farm, Port Shepstone	*Strey 9291* (GRA)	13	10
NATAL—2930 (Pietermaritzburg): Hella Hella	*Strey 9203* (GRA)	15	8

No evidence for abnormalities during meiosis was detected in *L. cooperi* during this survey, although apparently reliable counts of 12 and 14 had been obtained for *Strey 9291* previously (Jessop, 1970), which may indicate variability in number in different plants within the same population. (Figs. 1–3).

Ledebouria floribunda (Bak.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
CAPE—3325 (Port Elizabeth): Basson's Kloof, Zuurberg	*Bayliss BS/3920* (GRA)	10	8
NATAL—2831 (Eshowe): 1 mile south of Nkandla	*Jessop 1062* (GRA)	11	10
CAPE—3326 (Grahamstown): Woest Hill	*Jessop 1063* (GRA)	17	16

This population (*Jessop 1063*) is of plants somewhat intermediate between *L. floribunda* and *L. revoluta*. In general morphology they are closer to *L. revoluta*, but they have been placed in *L. floribunda* because of the large size of the bulbs (up to 100 mm or more long) and leaves (often 150–200 mm long). Evidence for polyploidy is inconclusive although the presence of multivalents was suspected.

NATAL—2930 (Pietermaritzburg): in forest along road	*Strey 9234* (GRA)	30	9

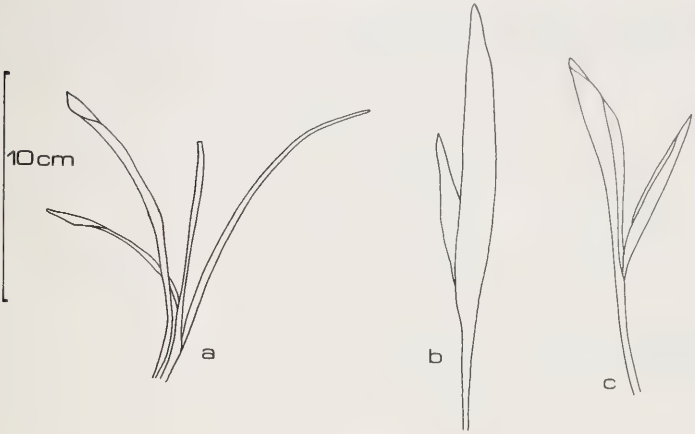

FIG. 1.
L. cooperi.
a. *Jessop 1061.* b. *Strey 9291.* c. *Strey 9203.*

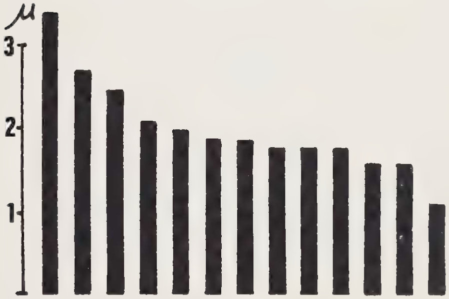

FIG. 2.
Chromosomes of *L. cooperi* (*Strey 9291*).

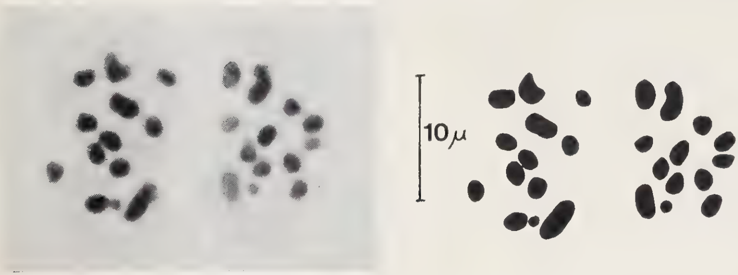

FIG. 3.
Chromosomes of *L. cooperi* (*Strey 9291*).

The only evidence for meiotic abnormalities in *L. floribunda* was suspected in *Jessop 1063*, which occurs in a district in which *A. revoluta* is frequent. It is possible that the specimen examined represents a polyploid or hybrid population involving *L. revoluta* but further evidence is needed. (Fig. 4).

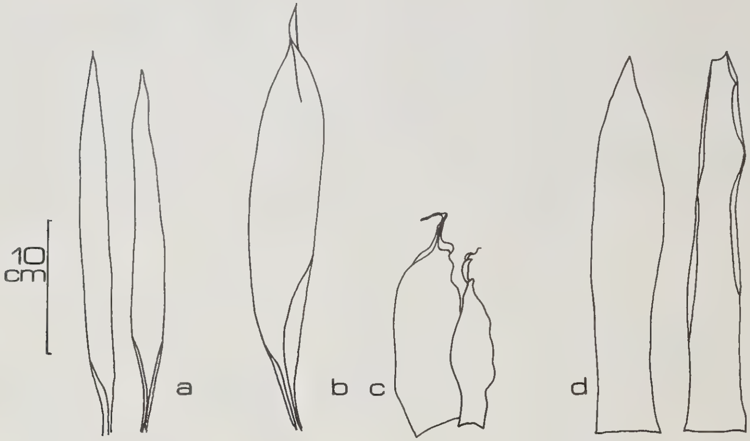

Fig. 4.
L. floribunda.
a. *Bayliss BS/3920.* b. *Jessop 1062.* c. *Jessop 1063.* d. *Strey 9234.*

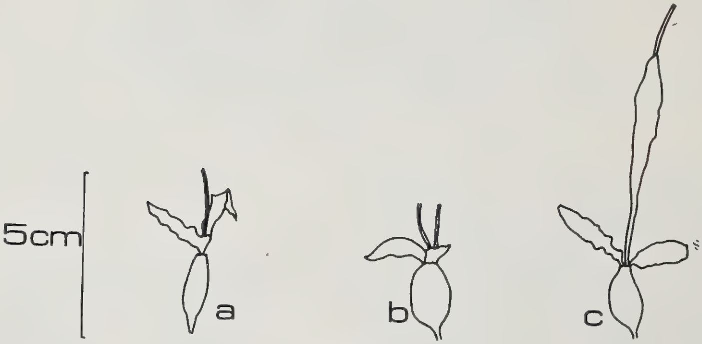

Fig. 5.
L. socialis.
a. *Tim* s.n. b. *Bayliss BS/3806.* c. *Bayliss BS/3224.*

Ledebouria socialis (Bak.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
CAPE—3326 (Grahamstown): Kariega	*Tim.* s.n. (GRA)	13	7
CAPE—3324 (Steytlerville): Andrieskraal, Baviaans Kloof	*Bayliss BS/3806* (GRA)	13	4
CAPE—3327 (Peddie): Wooldridge .	*Bayliss BS/3224* (RUH)	15	6

No meiotic abnormalities were detected in *L. socialis*, which is a particularly well-defined species, showing less morphological variation than do most species of *Ledebouria*. (Fig. 5)

Ledebouria concolor (Bak.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
CAPE—3326 (Grahamstown): Brooklands	*Bayliss BS/3377* (GRA)	18	6

(Fig. 6)

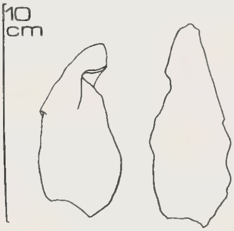

FIG. 6.
L. concolor. (*Bayliss BS/3377*).

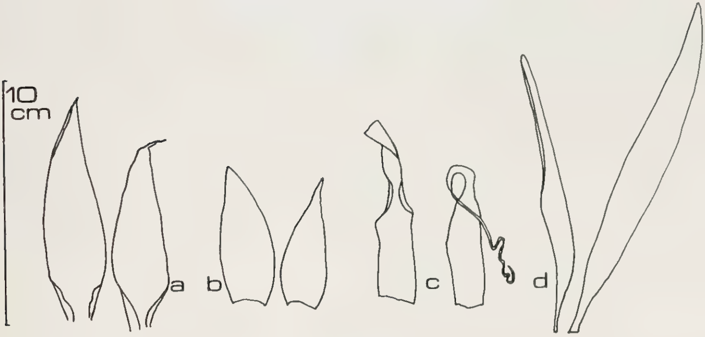

FIG. 7.
L. revoluta.
a. *Jessop 1064*. b. *Bayliss BS/3296*. c. *Strey 9292*. d. *Jessop 1065*.

Ledebouria revoluta (L.f.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
Rhodes University garden, origin unknown	*Jessop 1064* (GRA)	1) 9 2) 10 3) 10	11 8 12

The above counts are each derived from the inflorescence of separate bulbs within a clone.

CAPE—3325 (Port Elizabeth): Zuurberg, Henderson's Farm	*Bayliss BS/3296* (GRA)	10	14
NATAL—3030 (Port Shepstone): Mgongongo tributary to Tsotsha River, Wickman's Farm, Port Shepstone	*Strey 9292* (GRA)	10	11
TRANSVAAL—2428 (Nylstroom): 34 miles west of Potgietersrust . .	*Jessop 1065* (GRA)	1) 11 2) 22	7 10

These two sets of data were obtained from different flowers on the same inflorescence. While N = c. 22 was found on another flower of the same inflorescence, no other flowers with N = c. 11 were found.

NATAL—2829 (Harrismith): 5 miles west of Colenso	*Jessop 1066*	12	15
CAPE—3226 (Fort Beaufort): Kroomie	*Jacot Guillarmod* s.n. sub Rhodes Botany Dept Garden no. *167* (GRA)	13	14
NATAL—2831 (Eshowe): 7 miles south of Nkandla	*Jessop 1067* (GRA)	13	8
CAPE—3326 (Grahamstown): 2 miles north-west of Grahamstown	*Easton* s.n. sub Rhodes Botany Dept Garden no. *40* (RUH)	15	12
CAPE—3323 (Willowmore): Willowmore	*Bayliss BS/3887* (GRA)	16	12
SWAZILAND—2731 (Louwsberg): Ngwavuma	*Bayliss BS/3744* (GRA)	17	14

The only meiotic abnormalities recorded in *L. revoluta* were in *Jessop 1065*, where there appeared to be a reduction from N = 22 to N = 11. No explanation for a change of this type is suggested, but it is possible that the normal number is 11 with rather frequent polyploidy occurring. An additional count of N = 15 was reported by Jessop (1970) for a plant from a locality ten miles north of Pretoria. (Figs. 7 & 8)

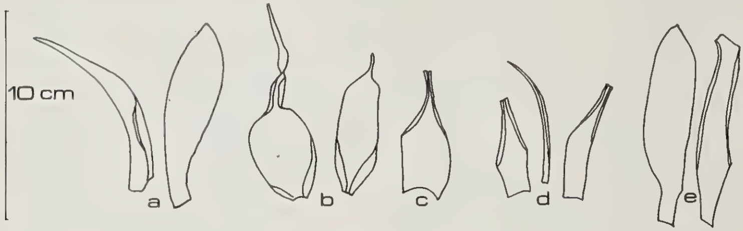

FIG. 8.

L. revoluta.

a. *Jacot Guillarmod* s.n. b. *Jessop 1067*. c. *Easton* s.n. d. *Bayliss BS/3887*. e. *Bayliss BS/3744*.

Ledebouria undulata (Jacq.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
CAPE—3327 (Peddie): Wooldridge .	*Bayliss BS/3224* (GRA)	10	10
CAPE—3323 (Willowmore): Willowmore	*Bayliss BS/3558* (GRA)	10	15
CAPE—3127 (Lady Frere): 18 miles west of Cala	*Jessop 1068* (GRA)	13	8
CAPE—3126 (Queenstown): Queenstown	*Bayliss* s.n. sub Rhodes Botany Dept Garden no. *178* (GRA)	14	15
CAPE—3326 (Grahamstown): Martindale	*Jessop 1053* (GRA)	15	14
CAPE—3325 (Port Elizabeth): Addo	*Bayliss* s.n. sub Rhodes Botany Dept Garden no. *179* (GRA)	c. 20 30	

Pairing (in *Bayliss* s.n. sub R.U.G. *179*) was irregular and laggards frequent. It is possible that this specimen is of a hybrid between *L. undulata* and *L. revoluta*, both of which are common and widespread in the area where it was collected. The leaves are rather narrow for the latter (up to about 8 mm broad) and rather linear. These characters suggest affinities with *L. cooperi* which is, however, very much less common. The bulb is distinctly of the *L. undulata* or *L. revoluta* type. (Figs 9—11)

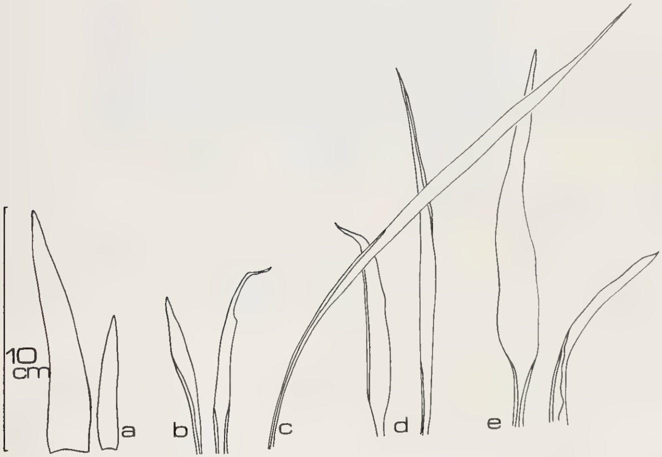

Fig. 9.

L. undulata.

a. *Bayliss BS/3224*. b. *Bayliss BS/3558*. c. *Jessop 1068*. d. *Bayliss* s.n. e. *Jessop 1053*.

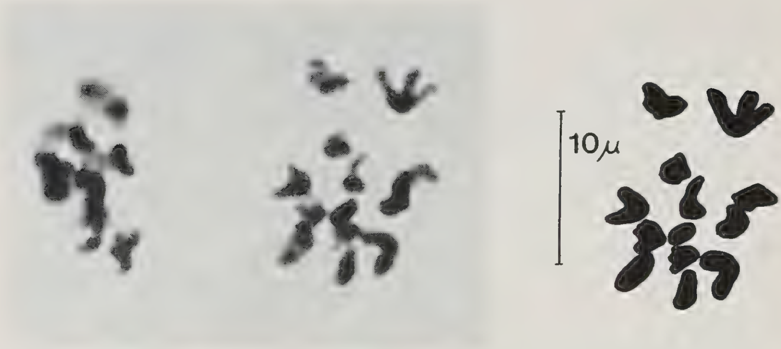

Fig. 10.
Chromosomes of *L. undulata* (*Jessop 1068*).

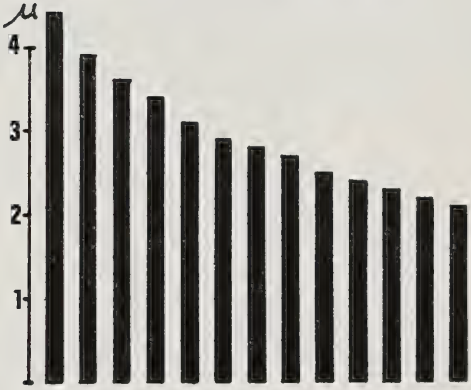

Fig. 11.
Chromosomes of *L. undulata* (Jessop *1068*).

Ledebouria marginata (Bak.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
CAPE—3127 (Lady Frere): Dordrecht	*Bayliss BS/3931* (GRA)	13	5

(Fig. 12a)

Ledebouria luteola Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
TRANSVAAL—2528 (Pretoria): 25 miles north of Pretoria	*Jessop 1057* (GRA)	46	4

(Fig. 12b)

Counts on sixteen cells varied from 39 to 56. Whether this only reflects the difficulties in counting a fairly large number of chromosomes or whether several haploid numbers existed could not be determined. (Fig. 12b)

Ledebouria ovatifolia (Bak.) Jess.

Locality	Collector, number, where housed	Haploid number	Number of cells counted
NATAL—2930 (Pietermaritzburg): near Howick	*Jessop 1069* (GRA)	27	7

(Fig. 12c)

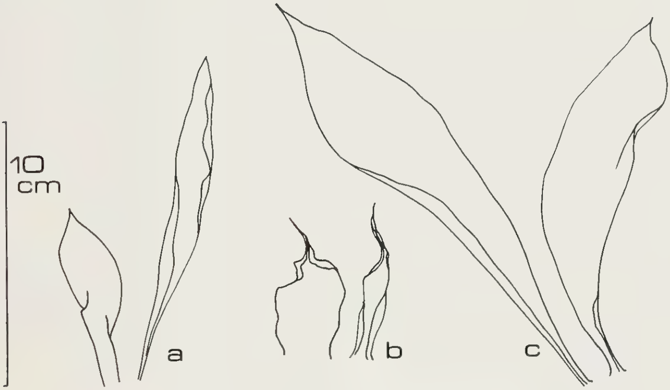

FIG. 12.

a. *L. marginata* (*Bayliss BS/3931*). b. *L. luteola* (*Jessop 1057*). c. *L. ovatifolia* (*Jessop 1069*).

Discussion

The following numbers are reported in the genus *Ledebouria* (including those previously reported), all expressed as the haploid number:

Haploid number	*Number of specimens whether of the same or different species*
6	1
9	1
10	8
11	2
12	2
13	7
14	1
15	5
16	1
17	2
18	1
22	2
23	2 (and one with 2N = 45)
27	1
29	1
30	2
?46	1

No basic numbers are suggested by the data presented in this table. This is apparently a feature shared with *Scilla*. Darlington & Wylie (1955) report basic numbers of 4, 6, 7, 8, 9, 10 and 11 for *Scilla*. Similarly, the South African genus *Lachenalia*, which resembles *Ledebouria* to some extent in vegetative and floral characters, is reported as having basic numbers of 7, 8, 11 and 13. *Drimiopsis*, which is also a related genus occurring in southern Africa, has not been studied in detail, but does appear to have similar chromosome features (Jessop, 1972). On the other hand, *Muscari*, which is a northern hemisphere member of the Scilleae, appears to be very consistent, with a basic number of 9 indicated for all fifteen species recorded by Darlington & Wylie. Whether this great variability of number in *Ledebouria* is as a result of the frequent occurrence of B-chromosomes or whether the chromosomes tend to fragment and perhaps rejoin has not been established. There is, however, little evidence of abnormalities in pairing in meiosis. An examination of the measurements (not recorded in this paper) of the meiotic chromosomes suggests that the lengths of the chromosomes in a complement is not inversely proportional to the number of chromosomes as might occur if the greater numbers were simply produced by fragmentation.

The lack of chromosomal number consistency in the species of *Ledebouria* examined, and the lack of obvious basic numbers or simple polyploid series, reduces the potential value of these studies in determining relationships or evolutionary sequences in the genus or between it and other genera. There appears on the data so far available to be no correlation, either, between numbers of chromosomes and distribution.

The behaviour of the chromosomes is to some extent parallelled in the problems of defining the species of this genus. Both morphological and cytological characters appear to vary almost continuosly without producing well-defined groupings. It is possible that the chromosomal variation is linked with a reduced fertility. Seeds are set in a very small percentage (perhaps about 1%) of flowers. Studies of embryo sac development are needed to establish whether or not development follows on fertilisation in the few fertile flowers. Hand pollination (both self and crossed) have failed to produce increased numbers of seeds.

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